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NATIONAL DAM SAFETY PROGRAM. BARBOURS POND DAM (NJ00241) PASSAI--ETC(U)
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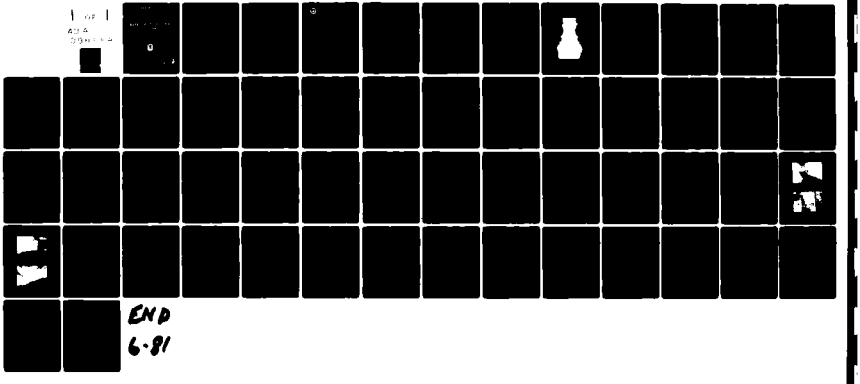

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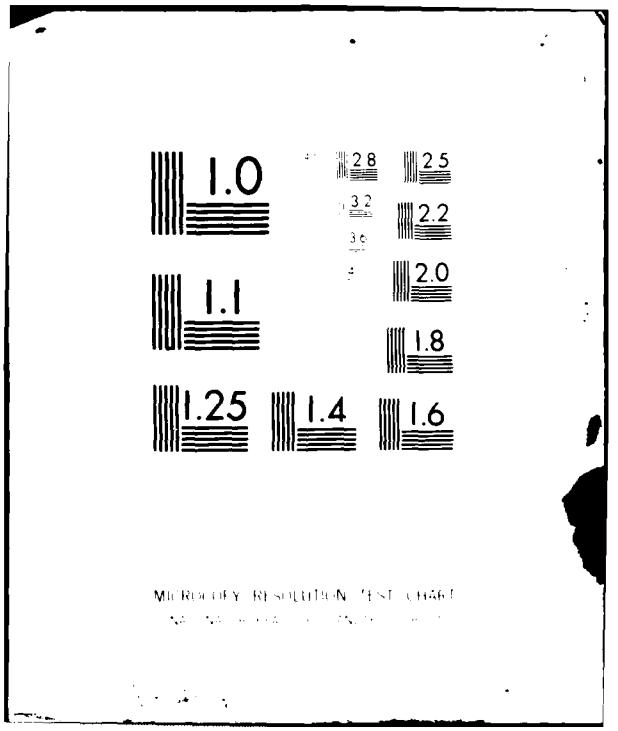
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PASSAIC RIVER BASIN
SLIPPERY ROCK BROOK, PASSAIC COUNTY
NEW JERSEY

BARBOURS POND DAM
NJ 00241

AD A098558

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

APPROVED FOR PUBLIC RELEASE;
DISTRIBUTION UNLIMITED.

DEPARTMENT OF THE ARMY
Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

MARCH 1981

Rept. no. DAEN/NAP-53842/NJ00241-81/03

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National Dam Safety Program
Barbours Pond Dam (NJ 00241)
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Abraham Perera

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Visual Inspection
Structural Analysis
National Dam Safety Program
Barbours Pond Dam, N.J.
Erosion

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO
NAPEN-N

24 APR 1981

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, New Jersey 08621

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Barbours Pond Dam in Passaic County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Barbours Pond Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in satisfactory overall condition and the spillway is considered adequate. To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The following actions should be completed within six months from the date of approval of this report:

(1) Remove excessive growth from the embankment slopes.

(2) Fill and regrade eroded areas on the upstream face of the dam.

(3) Repair and test the gate valve for the 12-inch drain pipe.

(4) Repair deteriorated concrete on the downstream retaining wall.

b. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam within one year from the date of approval of this report.

c. An emergency action plan should be developed which outlines actions to be taken by the owner to minimize the downstream effects of an emergency at the dam within six months from the date of approval of this report.

BARBOURS POND DAM (NJ00241)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 18 August 1980 by Louis Berger and Associates, Inc. under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Barbours Pond Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in satisfactory overall condition and the spillway is considered adequate. To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

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(3) Repair and test the gate valve for the 12-inch drain pipe.

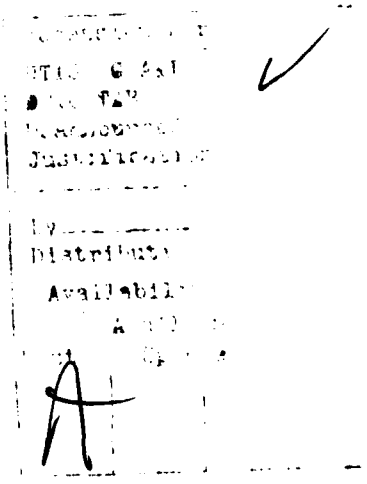
(4) Repair deteriorated concrete on the downstream retaining wall.

b. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam within one year from the date of approval of this report.

c. An emergency action plan should be developed which outlines actions to be taken by the owner to minimize the downstream effects of an emergency at the dam within six months from the date of approval of this report.

APPROVED: _____
JAMES G. TON
Colonel, Corps of Engineers
District Engineer

DATE: 21 [illegible] 1981



NAPEN-N
Honorable Brendan T. Byrne

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman Roe of the Eighth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Inspection Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

JAMES C. TON
Colonel, Corps of Engineers
District Engineer

1 Incl
As stated

Copies furnished:
Mr. Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief
Bureau of Flood Plain Regulation
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

Name of Dam Barbours Pond Dam Fed ID # 00241
NJ ID# 402

State Located	New Jersey
County Located	Passaic
Coordinates	Lat. 4054.0 - Long. 7411.0
Stream	Slippery Rock Brook
Date of inspection	August 18, 1980

ASSESSMENT OF GENERAL CONDITIONS

Barbours Pond Dam is considered to be in a satisfactory overall condition. Its spillway has adequate capacity to accommodate the 100-year design flood. It is recommended that the dam's hazard classification be downgraded to significant because a dam failure, while causing considerable downstream flood damage, would probably not result in loss of life. Remedial actions recommended to be undertaken in the near future include (1) removal of excessive growth from the embankment slopes, (2) filling and regrading of eroded areas on the upstream face of the dam, (3) repair and testing of the gate valve for the 12-inch drain pipe, (4) repair of deteriorated concrete on the downstream retaining wall, (5) formalization of operation and maintenance procedures, and (6) development of an emergency action plan and downstream warning system to minimize the hazard potential at this dam.

Abraham Perera P.E.
Project Manager

OVERVIEW OF BARBOUR POND DAM

AUGUST, 1980

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FIGURES

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
NAME OF DAM BARBOURS POND DAM FED # NJ00241
AND NJ ID # 402

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority

This report is authorized by the Dam Inspection Act, Public Law 92-367, and has been prepared in accordance with Contract FPM-36 between Louis Berger & Associates, Inc. and the State of New Jersey and its Department of Environmental Protection, Division of Water Resources. The State, in turn, is under agreement with the U.S. Army Engineer District, Philadelphia to have this inspection performed.

b. Purpose of Inspection

The purpose of this inspection is to evaluate the structural and hydraulic condition of the Barbours Pond Dam and appurtenant structures and to determine if the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

Barbours Pond Dam is a 142-foot-long, 20-foot-high, earth-fill dike (crest elevation 327.2) with a steel sheeting cut off that extends from elevation 325.5 down to bedrock. The embankment has a crest width of 13 feet and 1.5H:IV slopes. A 2-foot-thick, 4.5-foot-high concrete retaining wall is located at the downstream toe of the dam. This 66-foot-long wall is situated about 35 feet downslope from the crest and extends between two bedrock outcrops that border the embankment at both ends. An outlet drain consisting of a 98-foot-long, 12-inch-diameter, cast iron pipe is located 69 feet from the right abutment at invert elevation 307.2. Control valves are located in valve chambers situated (1) at the downstream toe adjacent to the retaining wall and, (2) on the upstream toe with the top of the chamber 3 feet below normal pool elevation. The primary outlet for this lake is located approximately 600 feet north of the dam

and consists of a 42-foot-wide overflow weir, the sill of which was formed by a rock cut in the basalt bedrock at elevation 320. The hydraulic control, however, lies about 43 feet downstream at the 16-foot-wide opening of the Mountain Avenue Bridge.

b. Location

Barbours Pond Dam is located within the Garrett Mountain Reservation slightly east of Mountain Avenue and approximately 1,000 feet north of the intersection of that roadway and Rifle Camp Road in West Paterson, New Jersey.

c. Size Classification

Barbours Pond Dam is approximately 20 feet high and impounds an estimated 202 acre-feet of water at maximum pool elevation. Based on the Guidelines for Safety Inspection of Dams, this dam is in the small size category.

d. Hazard Classification

Although Barbours Pond Dam is located in a populated area, it is recommended that the hazard classification be downgraded to significant on the basis of historical evidence, a 1945 failure, which suggests that a dam failure at this location, while causing considerable flood damage downstream, would probably not result in loss of life because the New Street Dam and Reservoir immediately downstream has the proven ability to contain a flood wave from Barbours Pond without failing (see Section 5, 5.1b-Experience Data)

e. Ownership

Barbours Pond Dam is owned by the Passaic County Park Commission, Lambert Castle, Valley Road, Paterson, N.J. 07503.

f. Purpose of Dam

Barbours Pond is utilized solely for recreational purposes.

g. Design and Construction History

Particulars of the original design and construction of Barbours Pond Dam are uncertain and apparently undocumented although it is known that the Barbour Flax-Spinning Company created the pond in the late

1870s for use by their industrial complex in Paterson. Prior to 1945, the property was acquired by the Passaic Valley Water Commission, which redesigned the north dike (Barbours Pond Dam App. No. 402) following its failure in July 1945. Reconstruction was completed by October 1946, but refilling of the pond was not allowed until August 1947 when the spillway crest (located elsewhere on the lake) had been lowered from elevation 324 to 320.

h. Normal Operational Procedures

The only regulating device at Barbours Pond Dam is the 12 inch drain located in the center of the dam. There are no specific operating procedures governing the regulation of either control valve for this outlet.

1.3 PERTINENT DATA

a. Drainage Area

The drainage area for Barbours Pond Dam is 0.6 square miles consisting of an undeveloped heavily wooded mountain-top reservation.

b. Discharge at Damsite

Maximum known flood at damsite - 637 cfs (1945)

Spillway capacity (at maximum pool elevation - 1206 cfs

c. Elevation (feet above NGVD)

Top Dam	-	+327.2
Recreation pool	-	+320.0
Spillway crest	-	+320.0
Streambed at centerline of dam	-	+307.2

d. Reservoir

Length of maximum pool	-	2,250 feet
Length of recreation pool	-	2,000 feet

e. Storage

Recreation pool	-	108 acre-feet
Top of dam	-	202 acre-feet

f. Reservoir Surface

Top of dam (maximum pool)	-	15.9 acres
Recreation pool	-	11 acres

g. Dam

Type	-	Earth with steel sheeting cutoff
Length	-	142 feet
Height	-	20 feet
Top width	-	13 feet
Side slopes	-	1.5H:1V
Zoning	-	2-Zone: impervious embankment upstream
Impervious core	-	None
Cutoff	-	Steel sheet piling
Grout curtain	-	None recorded

h. Diversion and Regulating Tunnel

None

i. Spillway

Type	-	Channel excavated through bedrock
Total length of weir	-	42 feet
Crest elevation	-	+320
Gates	-	None
U/S Channel	-	None
D/S Channel	-	Steep-sided channel excavated in basalt bedrock leading to concrete flume

j. Regulating Outlets

1-12 inch diameter, low level drain with control valves located on both upstream and downstream toe.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

There is no information available pertaining to the original design of Barbours Pond Dam. However, details of the redesigned dam were available from plans prepared by the Passaic Valley Water Commission in 1946 following the original dam's failure. In addition, information contained in the 1946 Dam Application Report provided the hydraulic criteria and physical parameters utilized in determining the design flood, modification of the spillway's crest elevation, and the dam design.

2.2 CONSTRUCTION

Little information is available regarding the actual construction of the dam, although field reconnaisance reveals construction followed the plans quite closely. The one exception is the slope of the downstream embankment, which appears to be 1.5H:1V rather than 2H:1V as indicated on the plans. However, inspection reports prepared by an engineer of the State Division of Water Policy and Supply indicate that the dam was built exactly as designed. The steel sheeting cutoff went to bedrock, which at this location consists of basalt originally laid down as a lava flow during the Triassic period. This hard, fine grained igneous rock provides an excellent foundation for the dam, although light seepage could be expected in time due to fracture permeability in the upper reaches of the foundation.

2.3 OPERATION

There is no information available with respect to the dam's operation since its reconstruction in 1946, with one exception. Shortly after the pond was allowed to refill in 1946, an inspection revealed the presence of light seepage some distance beyond the downstream retaining wall. Apparently the dam and spillway have functioned satisfactorily since the 1946 modifications.

2.4 EVALUATION

a. Availability

Sufficient design data were obtained to assess the hydrologic and hydraulic capacity of the pond and

dam. The structural stability of the dam can be assessed from details of the embankment, sheeting, and foundation described on the plans.

b. Adequacy

The data available for review are considered adequate to perform a valid assessment of the dam's existing condition and overall stability.

c. Validity

The 1945 H&H design criteria utilized are outdated with respect to contemporary design parameters. In addition, as-built modifications were not included in the original calculations. Accordingly, these data were recalculated using current H&H criteria, as depicted in the appendix.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General

Visual inspection of Barbours Pond Dam was conducted on August 19, 1980. The lake level at the time was several inches below the spillway crest and no discharge was observed in the channel immediately downstream of the spillway. The overall condition of the dam appeared satisfactory although some remedial measures are warranted, as noted below.

b. Dam

The embankment grades smoothly into the bedrock abutments at both ends of the dam. The crest of the dam consists of a well-compacted, heavily-traveled foot path with good horizontal alignment. Some erosion was noted on the upstream face as were several small trees and some light brush. The erosion appears to be due, primarily, to foot traffic, although several runoff gullies up to 2-feet in width were noted. The downstream slope is covered by trees up to 18 inches in diameter and light brush. The embankment appears stable and no slumping or cracking was noted, although the downstream slope, as determined with a hand level, is steeper than indicated on the plans. There is no discharge at this damsite, although dewatering is possible utilizing the low-level drain located at the center of the dam. The ground some 50 to 60 feet beyond the downstream toe of the dam was slightly damp but no seepage was noted during the inspection.

c. Appurtenant Structures

The design plans indicate the presence of two control valves for the 12-inch drain. However, only the valve chamber on the downstream toe was observed since the top of the chamber located on the upstream embankment is 3 feet below the lake's normal pool elevation. The steel cover plate was missing from the downstream chamber, which contained a considerable amount of litter and debris. The gate wheel is missing and the stem could not be seen through the litter. The downstream retaining wall exhibited some spalling and minor surface cracking, but generally appeared to be in good condition. No signs of significant movement of the

wall were noted, although the growth of a large tree against the valve chamber is displacing this structure, and the corresponding wall section, a small amount in the downstream direction. The 12-inch-diameter drain protruding from the base of the wall appeared rusty but clear at the time of the inspection.

d. Reservoir Area

As part of Garrett Mountain Reservation, the lake and drainage area is protected against surrounding development and is composed of first-growth woodlands. Bedrock outcrops are common along the shoreline, which rises abruptly from the lake surface. The terrain is relatively steep and irregular due in part to the bedrock outcrops and glacial scouring.

e. Downstream Channel

The channel below the dam no longer functions as an outlet for the lake except in the event of an emergency drawdown. It is lightly wooded and extends to Mountain Avenue, which forms the eastern boundary of the New Street Reservoir. The principal outlet channel located at the north end of the lake has a rather steep gradient with near vertical sides excavated in the bedrock. A steep concrete flume has been constructed just downstream of the New Street Reservoir Dam to insure containment of the runoff from both bodies of water. The channel and flume were both clear of debris or other significant impediments at the time of inspection.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

Operational procedures were not physically observed by the inspection team. Communication with personnel of the Passaic County Park Commission indicates that there are no formal operational regulations in force at this dam nor are any considered necessary in view of the high capacity of the uncontrolled spillway.

4.2 MAINTENANCE OF DAM

Maintenance at this dam is presently limited to landscaping and groundskeeping, which is performed as part of the Park Commission's daily routine maintenance program. Periodic inspections are conducted and repairs undertaken as permitted by funding considerations.

4.3 MAINTENANCE OF OPERATING FACILITIES

The only operational facility at this dam is the 12-inch diameter drain, which apparently has not been opened in recent years. Moreover, the valve must be considered inoperative until such time as the gate wheel is replaced and the valve is tested for functionability. It does not appear that this dam component is included among the general maintenance tasks performed by Park Commission Personnel.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

Park Commission personnel monitor the area during periods of heavy storms. They do not have a formalized plan for contacting civil defense or other authorities, but rely on their own monitoring and in-house methods of alerting local authorities.

4.5 EVALUATION OF OPERATIONAL ADEQUACY

Due to the self-regulatory nature of this impoundment, operational procedures are considered adequate, although it is felt that more vigorous maintenance should be applied to the downstream embankment with particular emphasis placed on the proper care and periodic operation of the valve and valve chamber.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data

In accordance with the criteria in the Recommended Guidelines for Safety Inspection of Dams, it has been determined that Barbours Pond Dam is small in size and of significant hazard. Accordingly, a 100-year frequency event was selected as the design storm. An inflow hydrograph for the drainage area of Barbours Pond was calculated using precipitation data from Technical Paper 40 and NOAA Technical Memorandum NWS Hydro-35. The inflow to the Pond for the selected 100-year storm was computed utilizing the HEC-1 computer program. The calculated peak flow to Barbours Pond was 1,118 cfs, and routing reduced the peak to 617 cfs. The maximum spillway discharge capacity before overtopping the dam is approximately 1,206 cfs. Thus, the spillway can accommodate the design flood and is therefore considered adequate.

b. Experience Data

There are no stream flow records available for the stream flowing into the Barbours Pond Dam. The Dam Application Report for the 1946 reconstruction of the dam (Application No. 402) indicates that the design flow was 690 cfs. A letter from the Passaic Valley Water Commission dated Aug. 29, 1945 addressed to the N.J. Department of Conservation indicates that the maximum flow over the weir of the original dam before its failure was calculated to be 637 cfs on the basis of measured depth of water over the weir. As a result of the dam breach, approximately 60 million gallons emptied directly into the New Street Reservoir in a very short period of time and it was necessary to close the valves to its distribution system. There is no record of any additional damage to the downstream dam and appurtenances other than silt in the lines and a loss of water pressure due to removal of the reservoir from the system. When Barbours Pond Dam was rebuilt, a by-pass channel was constructed to conduct discharges around the New Street Reservoir.

c. Visual Observation

The present spillway at the lake consists of an opening under the Mountain Avenue bridge. The top of the bridge is at approximately the same elevation as the top of the dam. However, between the right abutment of the dam and the Mountain Avenue bridge the pond shoreline is a few feet lower in elevation. At the time of inspection the water level was below the spillway crest elevation. The pond shorelines appear stable. Rock outcroppings form a large portion of the shoreline near the dam. The bottom of the channel under the Mountain Avenue bridge was cut into the existing basalt bedrock.

d. Overtopping Potential

Because the opening under the Mountain Avenue bridge constitutes a spillway of almost twice the required capacity, there is no potential for the overtopping of the dam during a 100-year frequency flood. Even if a higher intensity flood were to occur, the rising waters would spill first through a low spot in the pond shoreline before the dam could be overtopped.

e. Drawdown

The pond can be dewatered down to elevation 307.2 in approximately 6.8 days. This could be accomplished by opening the two gate valves (one upstream, the other downstream) of the 12-inch-diameter drain pipe. However, neither valve appears to be operable.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observation

Based on the visual inspection, the Barbours Pond Dam appears to be in sound structural condition. There was no evidence either on the slopes or at the crest of the dam embankment of any movement, settlement, or seepage. The abutments of the dam blend well into the adjacent rock outcrops. The downstream slope is heavily overgrown with trees. The retaining wall at the toe of the downstream slope appears in satisfactory condition with no indication of movement or structural cracking. Only a few areas of the concrete surface show minor spalling and hairline cracking.

b. Design and Construction Data

Structural design calculations and stability analyses for either the original or the reconstructed dam were not available for this dam. Based on field observations and drawings prepared by the Passaic Valley Water Commission in 1946, the dam is constructed on underlying bedrock and has a steel sheeting cut-off curtain. Its downstream toe is anchored against a retaining wall, which also appears founded on bedrock. Based on these data, the dam is believed to be conservatively designed and structurally stable.

c. Operating Records

Written operating records are non-existent.

d. Post Construction Changes

There is no record of post construction changes to this dam, which was reconstructed in 1946.

e. Seismic Stability

The dam is located in Seismic Zone 1 and, due to its embankment height/width ratio, it has negligible vulnerability regarding earthquake loading intensities because it is statically stable. Experience indicates that dams in Zone 1 will have adequate stability under dynamic loadings if stable under static loading conditions.

SECTION 7 - ASSESSMENTS/RECOMMENDATIONS/ REMEDIAL ACTIONS

7.1 DAM ASSESSMENTS

a. Safety

Subject to the inherent limitations of the Phase I visual inspection, the Barbours Pond Dam is judged to be in a satisfactory overall condition. The spillway has more than sufficient capacity to handle the design flood and the dam is in sound structural condition. Therefore, it is considered adequate with respect to overtopping or structural failure.

b. Adequacy of Information

The data located are deemed adequate regarding the enclosed analysis of safe operation and stability.

c. Urgency

It is recommended that the remedial measures described below be performed sometime in the near future.

d. Necessity for Further Study

Further studies are believed to be unnecessary under the purview of P.L. 92-367. However, in view of the hazard classification for this dam, it would be desirable that the owner institute a plan for inspection of the dam to ascertain its continued good functioning, particularly during severe storms.

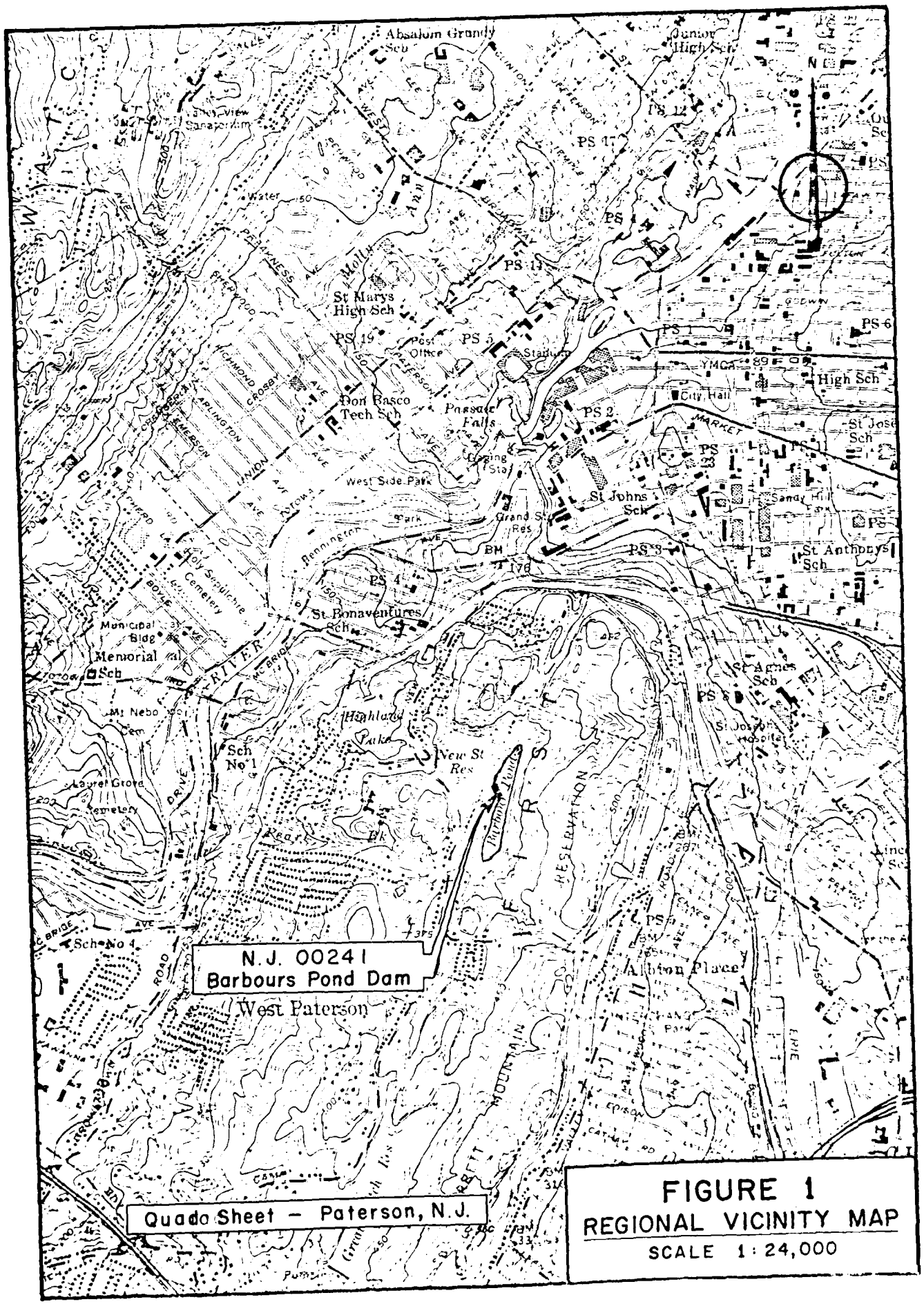
7.2 RECOMMENDATIONS/REMEDIAL MEASUREMENTS

a. Recommendations

Although the embankment of the dam is protected by the steel sheeting and concrete retaining wall at the toe, it would be desirable to clear the tree and brush growth to minimize damage due to root growth. Similarly, the upstream and downstream gate valves controlling the 12-inch-diameter cast iron pipe drain should be made operable in case it becomes desirable to drain the pond. The deteriorated concrete in the retaining wall should be repaired.

b. O&M Maintenance and Procedures

In the near future, the owner should develop (1) written operating procedures and a periodic maintenance plan to insure the continued safety of the dam, and (2) an emergency action plan and downstream warning system to minimize the hazard potential of this dam. It is further recommended that the drain be operated periodically to insure its proper functioning and to keep the intake area free of excessive siltation.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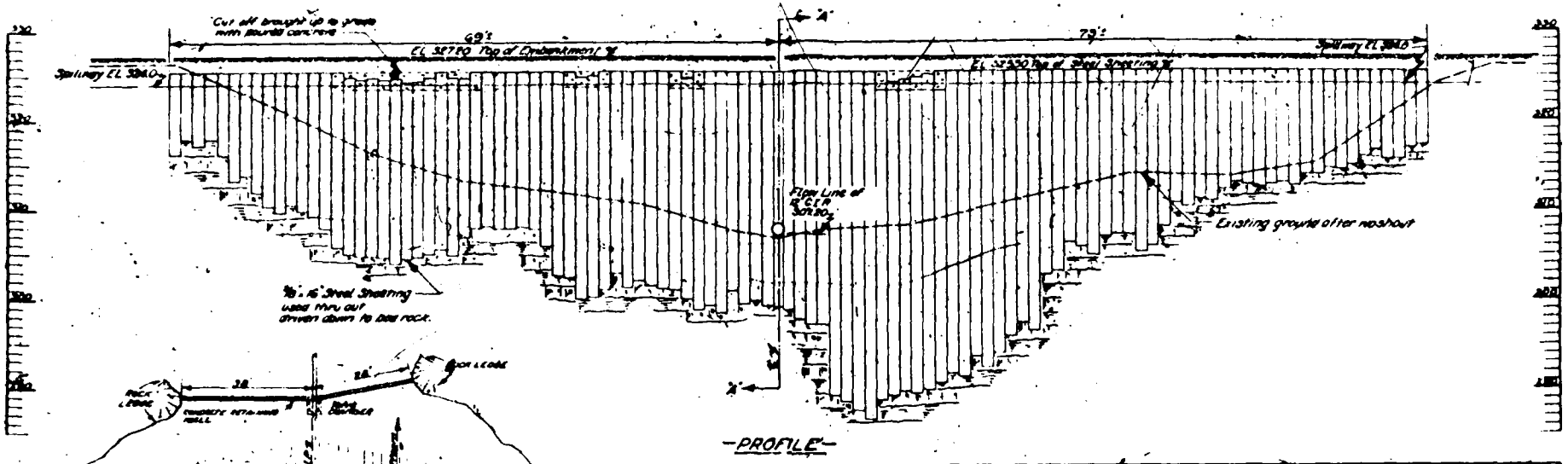
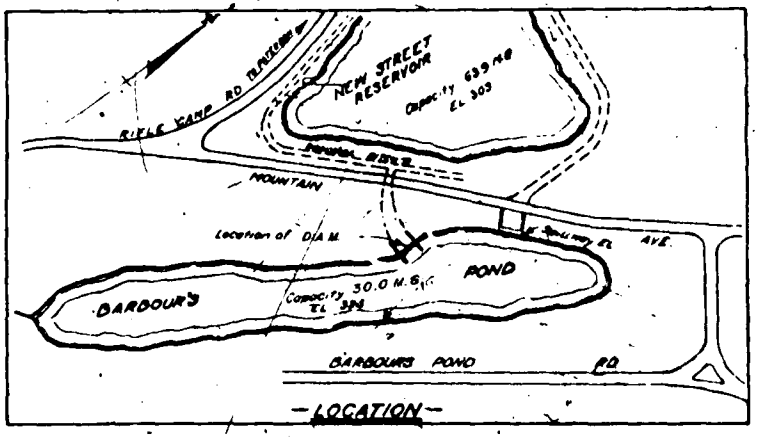
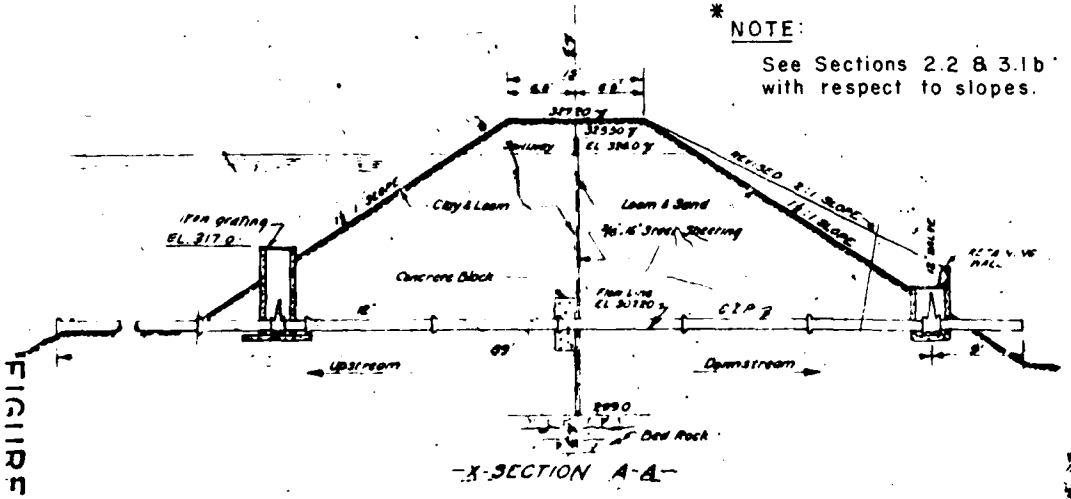
Laurel Grove Cemetery
Holy Sepulchre Cemetery
Mt Nebo Cem
Highland Park
West Side Park
Grand St Res
New St Res
Barbours Pond
Alabon Place
Post Office
Stadium
YMCA
Water
PS 1
PS 2
PS 3
PS 4
PS 5
PS 6
PS 8
PS 11
PS 12
PS 17
PS 19
PASSAIC RIVER
MOUNTAIN
RESERVATION
FIGURE 1
REGIONAL VICINITY MAP
SCALE 1 : 24,000

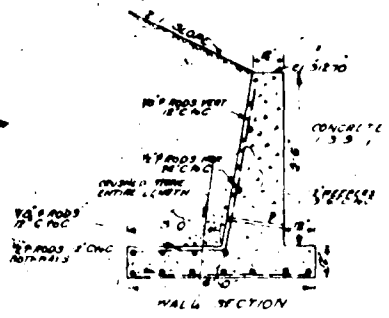




* NOTE:

See Sections 2.2 & 3.1b with respect to slopes.



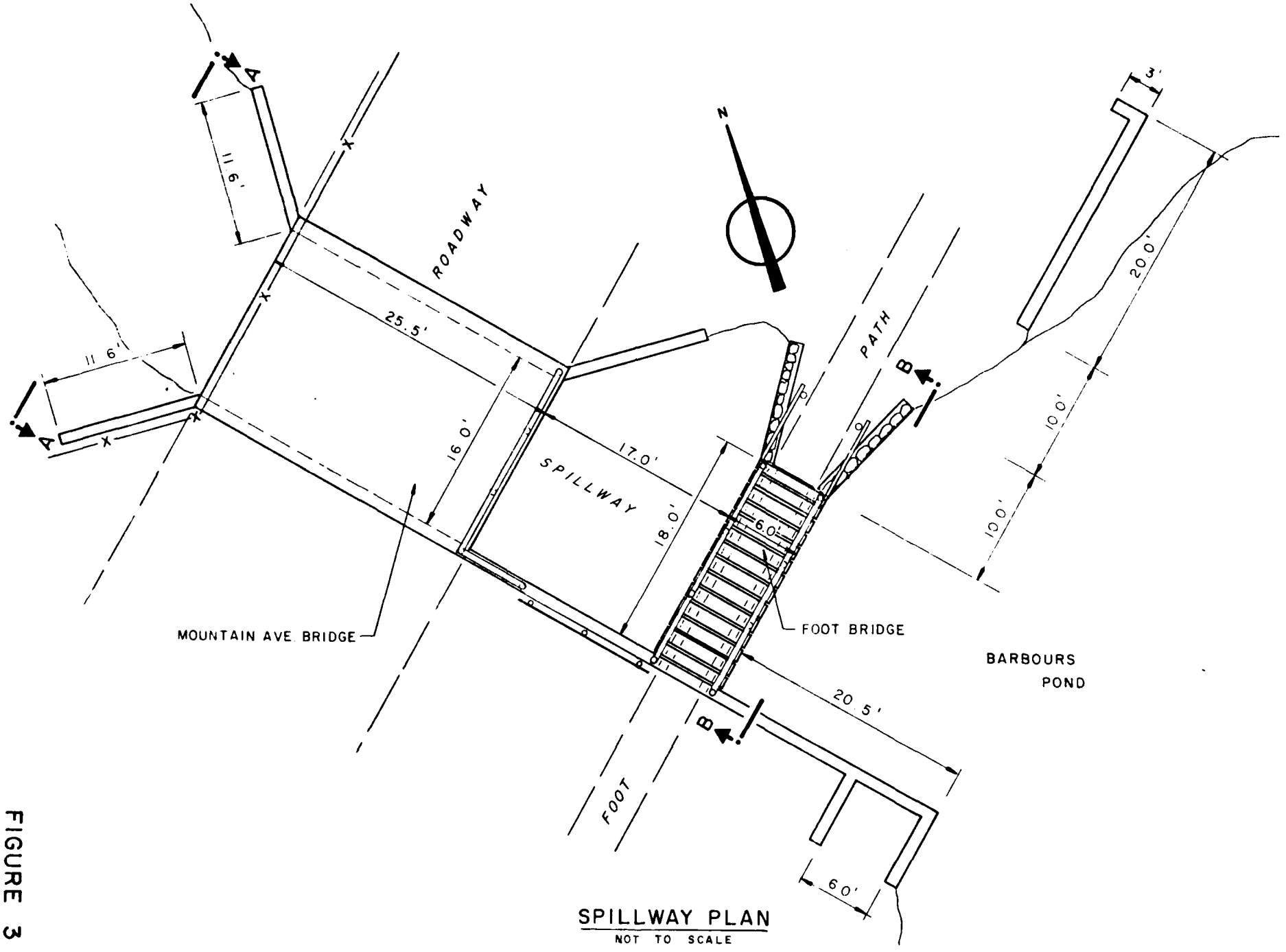


BARBOURS POND DAM

NOT TO SCALE

FIGURE 6

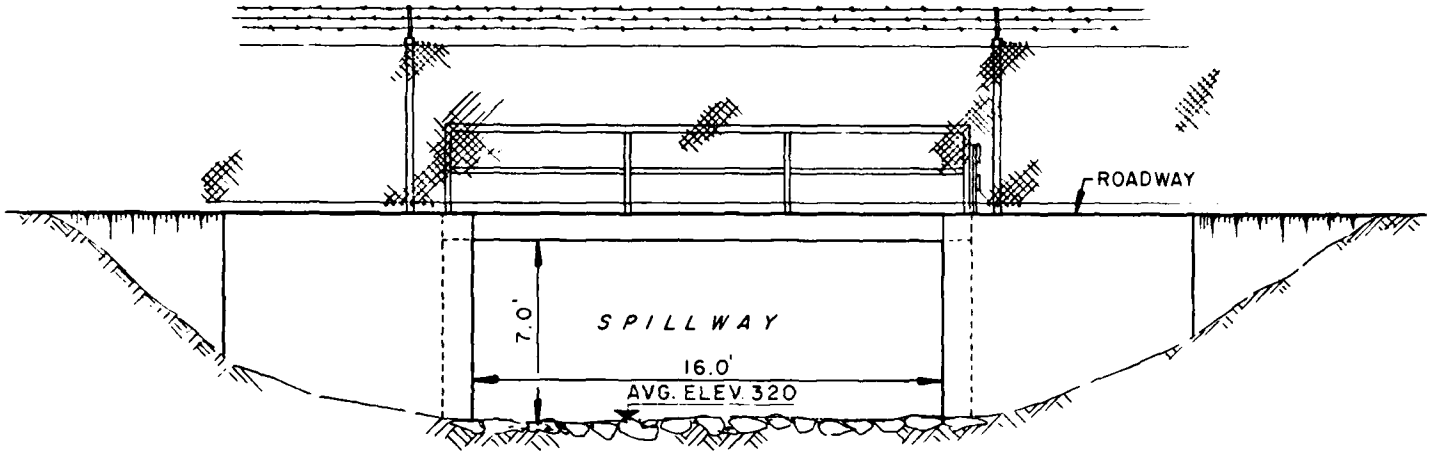
* From: Passaic Valley Water Commission Drawing, Jan. 1946



SPILLWAY PLAN

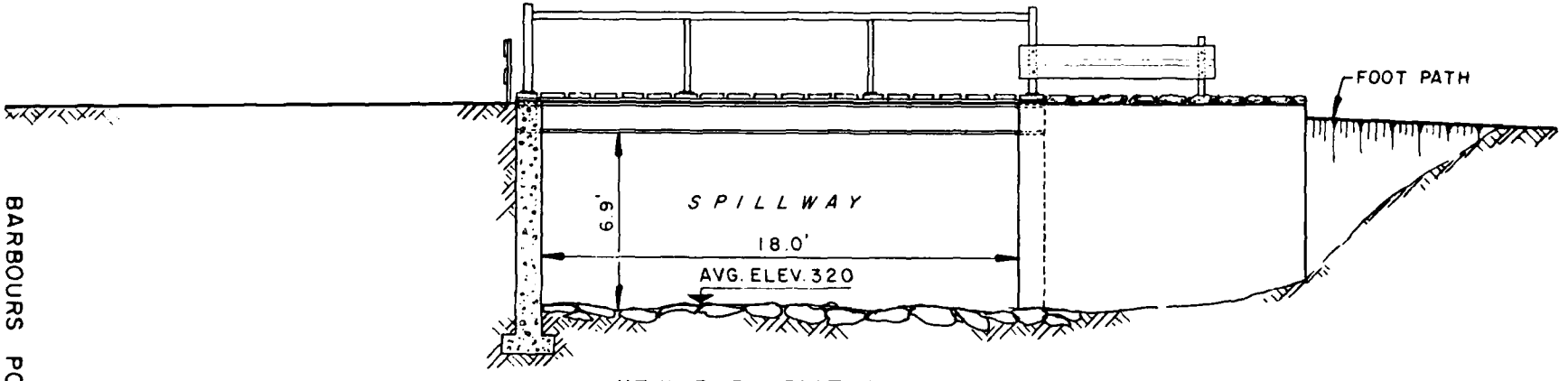
NOT TO SCALE

FIGURE 3



VIEW A-A MOUNTAIN AVE. BRIDGE

NOT TO SCALE



VIEW B-B FOOT BRIDGE

NOT TO SCALE

FIGURE 4

BARBOURS POND DAM

Check List
Visual Inspection
Phase 1

Name Dam Barbour Pond County Passaic State New Jersey Coordinators NJDEP

Date(s) Inspection 8/19/80 Weather Overcast Temperature 75°C

Pool Elevation at Time of Inspection 319± NGVD Tailwater at Time of Inspection None NGVD

Inspection Personnel:

A. Perera (LBA) T. Chapter (LBA) _____

J. Greenstein (LBA) _____ _____

R. Lang (LBA)

T. Chapter Recorder

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None Observed	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None Observed	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Light erosion along entire upstream slope due to pedestrian traffic and surface runoff. Erosion gullies up to 1.5' deep.	Eroded areas should be filled and a good grass cover established.
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	Crest alignment is satisfactory.	No slumping or sagging observed.
RIPRAP FAILURES	None Observed	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VEGETATION	Heavy growth and trees on both slopes with some trees on downstream embankment up to 18" in diameter. Small tree is wedging portion of toe wall out of line. About 1/2" of movement.	Brush should be cut back. All trees including those endangering retaining wall should be removed.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Good Condition.	Embankment grades smoothly into adjoining bedrock abutments.
ANY NOTICEABLE SEEPAGE	Forest floor slightly damp about 50 feet downstream of outlet pipe. No noticeable seepage.	Principal spillway located 600' north of dam. Outlet pipe in dam is no longer used and original channel is now a gently sloping wooded area.
STAFF GAGE AND RECORDER	None	
DRAINS	Unknown	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Light spalling on retaining wall in area of valve chamber and 12" CIP. Slight (1/2 inch) movement at cold joint due to tree growth.	Surface concrete deterioration should be patched, brush and trees removed
INTAKE STRUCTURE	Not visible if any exist.	
OUTLET STRUCTURE	2' x 2' valve chamber immediately upstream and adjoining retaining wall. Cover plate missing. Some spalling. Wheel not visible. Filled with leaves and dirt.	Valve chamber should be cleared of debris, gate wheel replaced and tested, and cover plate replaced and locked. Valve should be operated periodically (approx. 4 times/year).
OUTLET CHANNEL	Natural wooded park area.	Could still be utilized for dewatering since the swale leads to a culvert under Mountain Ave. and into New St. Reservoir.
EMERGENCY GATE	Second valve chamber located on upstream side of dam below the normal lake elevation.	Unable to comprehend reason for control at this location and elevation unless only utilized for construction period.

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	N/A. Sill is cut into solid basalt bedrock. Very irregular blocky surface. Some cement skin.	Floor of sill could be smoothed with concrete or asphalt skin to improve flow characteristics and capacity. Not critically necessary, however.
APPROACH CHANNEL	Same condition as sill described above.	Same consideration as sill above.
DISCHARGE CHANNEL	Bedrock channel continues under Mountain Ave.. High retaining wall on left, wing walls and bedrock on right.	
BRIDGE AND PIERS	Mountain Ave. bridge opening is 7' x 16'. Bridge about 30' downstream of spillway sill.	Channel under bridge is continuous with spillway sill and the bridge opening provides the hydraulic control for the discharge capacity.

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Moderately steep wooded slopes to north. Primarily undeveloped drainage area.	Pleasant recreational area. Eastern slopes are not steep enough to warrant landslide concern.
SEDIMENTATION	Northern end of pond silting in. Does not appear substantial in area of dam.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Area immediately downstream of spillway is an artificial channel cut into bedrock. About 1000' further downstream at New St. Dam is a 200-foot-long, 5' x 12', asphalt-lined, trapezoidal flume leading to the Rifle Camp Road Bridge. A wooden flap-gate spans the channel immediately upstream of the flume. No debris noted.	Preliminary calcs. indicate the flume has greater hydraulic capacity than the bedrock channel due to the former's steeper, smoother slope. Flap-gate is no constriction to flood flows.
SLOPES	Channel gradient about 4% to flume. Gradient of flume about 20%. Channel slopes in bedrock about 1H:3.5V. Area wooded above rock cuts.	
APPROXIMATE NO. OF HOMES AND POPULATION	No homes within flood plain of deeply incised channel between dam and Route 80 about 1 mile downstream.	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	Available - microfilm - NJDEP, Prospect Street, Trenton, New Jersey 08625
REGIONAL VICINITY MAP	Available - U.S.G.S. Quadrangle - Paterson, N.J.
CONSTRUCTION HISTORY	Original Unavailable - 1946 reconstruction history available - NJDEP microfilm
TYPICAL SECTIONS OF DAM	Available - NJDEP microfilm
HYDROLOGIC/HYDRAULIC DATA	Available - NJDEP microfilm
OUTLETS - PLAN	Available - NJDEP microfilm
- DETAILS	Available - NJDEP microfilm
- CONSTRAINTS	Not Available
- DISCHARGE RATINGS	Not Available
RAINFALL/RESERVOIR RECORDS	Not Available

ITEM	REMARKS
SPILLWAY PLAN	N/A
SECTIONS	
DETAILS	
OPERATING EQUIPMENT PLANS & DETAILS	N/A

ITEM	REMARKS
DESIGN REPORTS	Not Available
GEOLOGY REPORTS	Available - State Geologic Map and Rutgers Engineering Soil Survey
DESIGN COMPUTATIONS	Available - NJDEP microfilm
HYDROLOGY & HYDRAULICS	Available - NJDEP microfilm
DAM STABILITY	Not Available
SEEPAGE STUDIES	Not Available
MATERIALS INVESTIGATIONS	Not Available
BORING RECORDS	Not Available
LABORATORY	Not Available
FIELD	Not Available
POST-CONSTRUCTION SURVEYS OF DAM	Not Available
BORROW SOURCES	Not Available

ITEM	REMARKS
MONITORING SYSTEMS	Patrolled by park employees
MODIFICATIONS	Available - NJDEP microfilm
HIGH POOL RECORDS	Not Available
POST CONSTRUCTION ENGINEERING	Not Available
STUDIES AND REPORTS	Not Available
PRIOR ACCIDENTS OR FAILURE OF DAM	Dam breach in 1945 (See Section 5.1 b)
DESCRIPTION	Available - NJDEP microfilm
REPORTS	Available - NJDEP microfilm
MAINTENANCE	Not Available
OPERATION	Not Available
RECORDS	Not Available

August, 1980

View of Crest from Right Abutment

August, 1980

View of Retaining Wall and Valve Chamber

August, 1980

View of Principal Outlet

August, 1980

View of Downstream Channel and Flume

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 0.6 sq. mi.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 320 (108 + acre feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): N/A

ELEVATION MAXIMUM DESIGN POOL: Unknown

ELEVATION TOP DAM: 327.2 (202 acre feet)

CREST: Spillway channel located 600 feet north of dam

a. Elevation 320
b. Type Bedrock sill
c. Width 42 Feet
d. Length 69 Feet including control section
e. Location Spillover 600 + feet north of dam
f. Number and Type of Gates None

OUTLET WORKS:

a. Type 12" dia. C.I. drain
b. Location 69 Feet from right abutment
c. Entrance inverts 307.2
d. Exit inverts 307.2
e. Emergency draindown facilities Same

HYDROMETEOROLOGICAL GAGES: None

a. Type
b. Location
c. Records

MAXIMUM NON-DAMAGING DISCHARGE: 1206 cfs

BY _____ DATE _____ **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A1 OF A14
CHKD. BY _____ DATE _____ EARLEVILLE DAM PROJECT C-262
SUBJECT _____

TIME OF CONCENTRATION:

LENGTH ALONG LONGEST WATER SOURCE TO DRAINAGE DIVIDE = 5250'
≈ 1.0 mi

$\Delta H = 95'$ ∴ SLOPE = 1.80%

ASSUME VELOCITY OF 2'/sec.

$\therefore t_c = 5250' / (2'/sec \times 3600) = 0.73$ HOUR

CALIFORNIA CULVERTS METHOD:

$$t_c = \left(\frac{11.9 \times 1^3}{95} \right)^{0.385} = 0.45 \text{ HOUR}$$

BY SCS METHOD (FROM URBAN HYDROLOGY FOR SMALL WATERSHEDS, TECHNICAL RELEASE 100.55)

ASSUME C_N FOR WATERSHED = 75
SLOPE = 1.80%
ℓ = 5250'

$$L = \frac{\ell^{0.8}(S+1)^{0.7}}{1900 Y^{0.5}} = \frac{5250^{0.8}(3.33+1)^{0.7}}{1900 (1.8)^{0.5}}$$ WHERE $S = \frac{1000}{C_N} - 10$

$= 1.04$ HOURS

$t_c = \frac{L_{CG}}{0.6} = \frac{1.04}{0.6} = 1.73$ HOURS

USE $t_c = 0.93$ HOURS

$T_p = D/2 + 0.6 t_c = \frac{0.25}{2} + 0.6(0.9') = 0.67$ HOURS

LOUIS BERGER & ASSOCIATES INC.

$$Q_P = \frac{484 \times .59 \times 1}{0.67} = 426 \text{ cfs}$$

Unitgraph Time (hours)	T/Tp	Dimensionless Ordinate (D.O.)	Q Qp x D.O. (cfs)
0.25	0.37	0.244	104
0.50	0.75	0.83.	354
0.75	1.12	0.968	412
1.00	1.49	0.669	285
1.25	1.87	0.385	164
1.50	2.24	0.228	97
1.75	2.61	0.128	55
2.00	2.99	0.076	32
2.25	3.36	0.047	20
			Σ 1523

CHECK:

$$\frac{1523 \times 12 \times 3600}{4 \times 0.59 \times 5280^2} = 1.00001 \cong 1 \text{ inch}$$

BY D. LANG DATE AUG. 80 — **LOUIS BERGER & ASSOCIATES INC.** SHEET NO 45 OF [illegible]

CHKD. BY ______ DATE ______ [illegible] PROJECT [illegible]

SUBJECT Test Storm, 100 year Frequency

PRECIPITATION DATA FROM TP-40 + NOAA TECHNICAL MEMORANDUM NWS HYDRO 35

TIME	PRECIPITATION	Δ	REARRANGE Δ
0.25	1.7	[illegible]	[illegible]
0.50	[illegible]4	0.7	[illegible]
0.75	2.8	0.4	0.06
1.00	3.1	[illegible]3	[illegible]
1.25	3.4	0.3	0.07
1.50	3.7	0.3	0.07
1.75	3.86	0.16	0.08
2.00	4.00	0.14	0.[illegible]
2.25	4.11	0.11	0.14
2.50	4.22	0.11	0.16
2.75	4.31	0.[illegible]	0.3
3.00	4.40	0.07	0.3
3.25	4.49	0.[illegible]	0.3
3.50	4.57	[illegible]	0.7
3.75	4.64	0.07	1.70
4.00	4.71	0.07	[illegible]
4.25	4.78	0.07	0.4
4.50	4.8[illegible]	0.06	0.11
4.75	4.90	0.[illegible]	[illegible]
5.00	4.96	0.[illegible]	[illegible]
5.25	5.02	0.[illegible]	[illegible]
5.50	5.0[illegible]	[illegible]	[illegible]
5.75	5.14	[illegible]	[illegible]
6.00	5.20	[illegible]	[illegible]

BY _____ DATE _____ **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A4 OF A14

CHKD. BY _____ DATE _____ EARTH FILL DAM PROJECT _____

SUBJECT _____ SPILLWAY DISCHARGE CAPACITY

MOUNTAIN AVENUE BRIDGE CONTROL DISCHARGE 16.0' x 7.0'

SLOPE = 1%

$n = 0.040$

MANNING'S EQUATION:

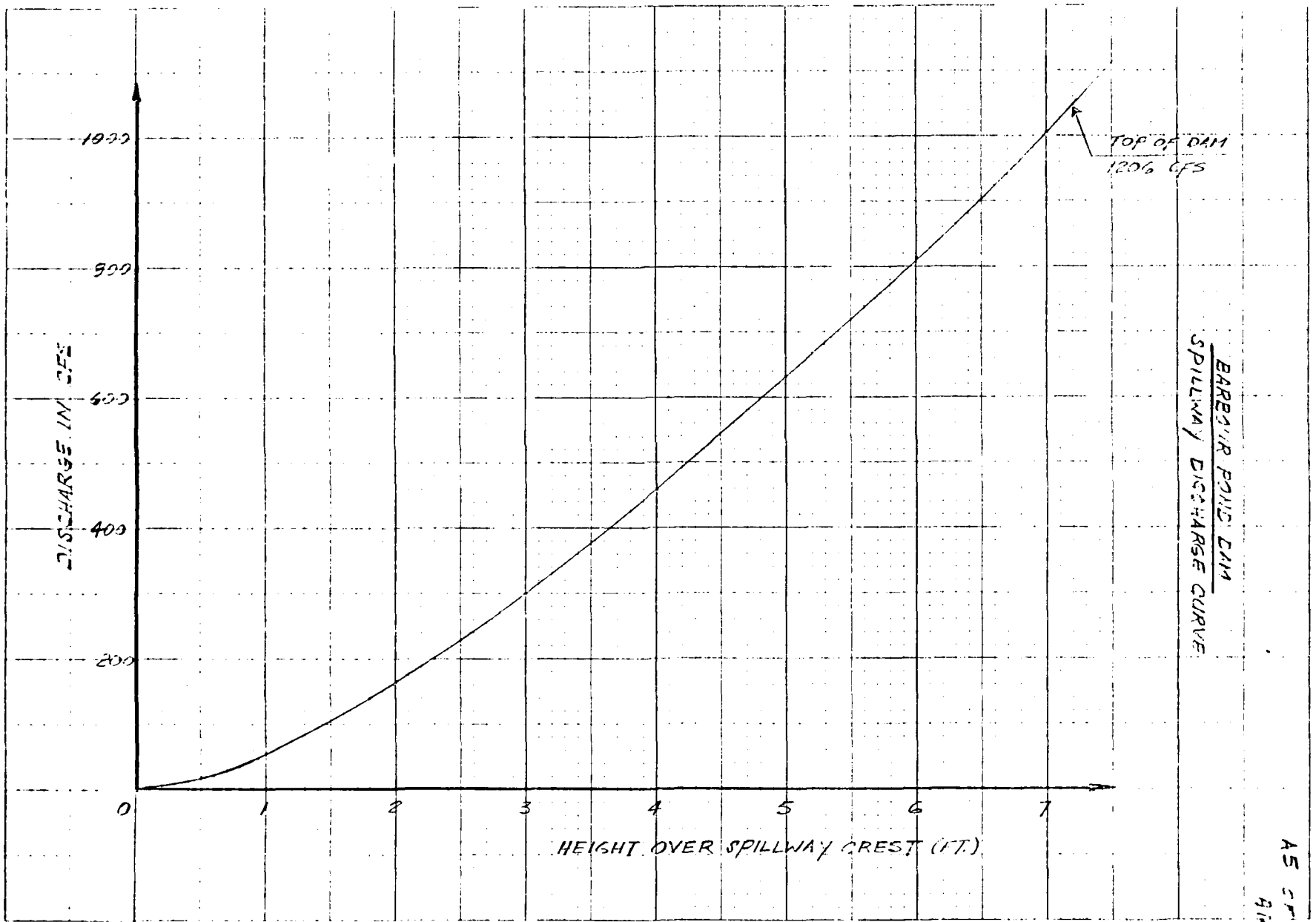
$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

ELEV.	h	A	P	R	S	n	$R^{2/3}$	$S^{1/2}$	Q
320.0	0				0.01	0.040		0.10	
321.0	1	16	18	0.89			0.92		55
322.0	2	32	20	1.60			1.37		163
323.0	3	48	22	2.18			1.68		300
324.0	4	64	24	2.67			1.92		458
325.0	5	80	26	3.08			2.12		632
326.0	6	96	28	3.43			2.27		812
327.0	7	112	30	3.73			2.41		1005

BEGIN CULVERT FLOW

$CA\sqrt{2gH}$ $A = 112$ $C = 0.60$

ELEV.	H	Q	
327.2	7.2	1206	TOP OF DAM


BARBOUR POND DAM
SPILLWAY DISCHARGE CURVE
TOP OF DAM
1206 CFS
DISCHARGE IN CFS
1000
900
600
400
200
0
1
2
3
4
5
6
7
HEIGHT OVER SPILLWAY CREST (FT.)

BY. _____ DATE Sept. '80

CHKD. BY _____ DATE _____

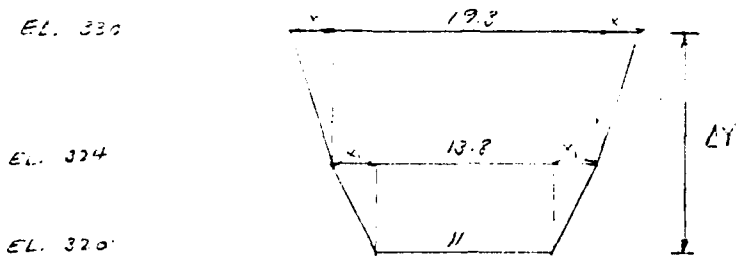
SUBJECT Proposed Flood Dam
Quantity Calculations

LOUIS BERGER & ASSOCIATES INC.

SHEET NO. A6 OF A14

PROJECT _____

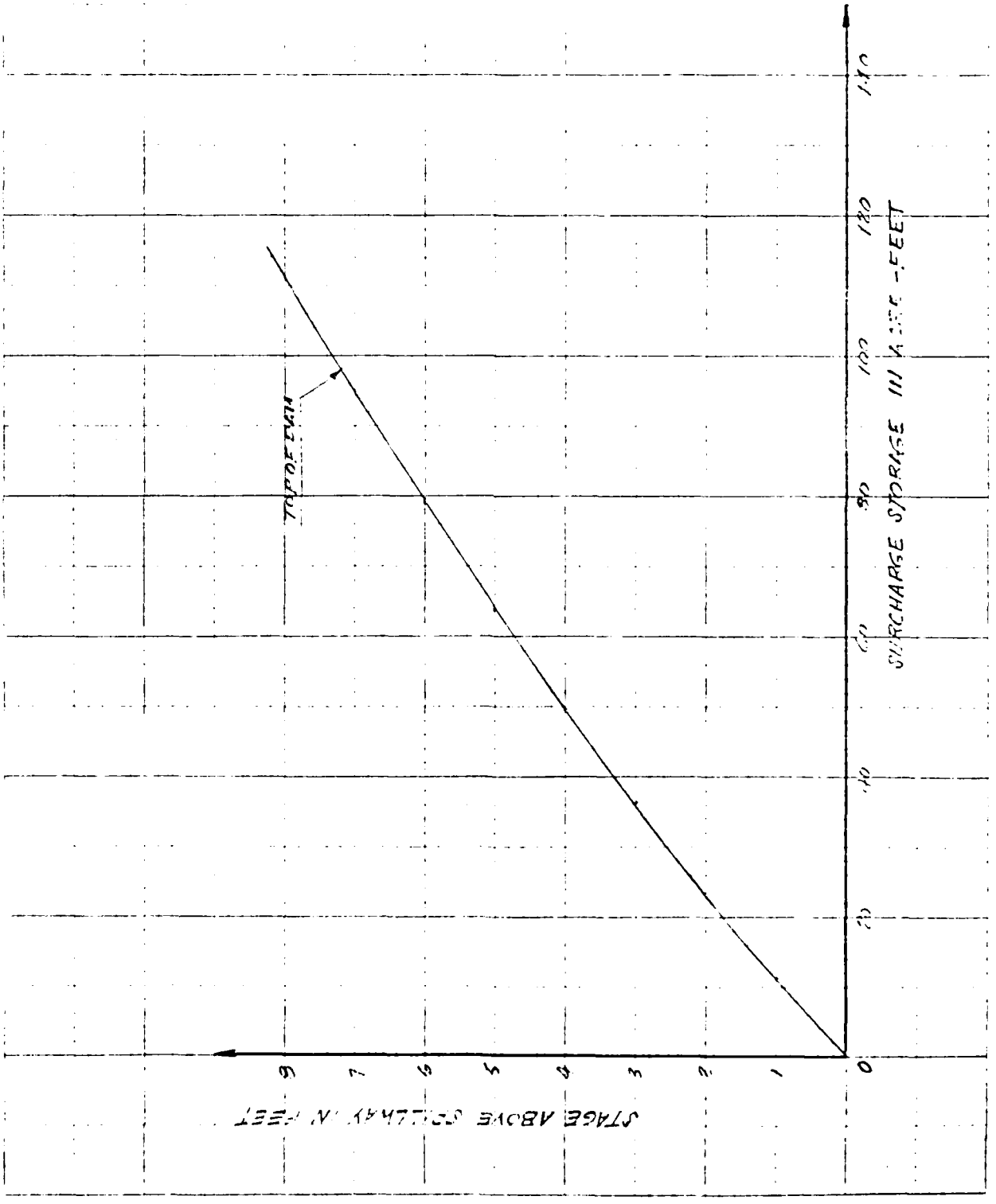
AREA OF LAKE @ ELEV. 320.0 = 11 ACRES
AREA @ ELEV 324.0 = 13.8 ACRES (ORIGINAL POOL)
AREA @ ELEV 320.0 CONTOUR = 19.3 ACRES



$\Delta V = \Delta Y (X + \Delta X)$

ELEV.	HEIGHT ABOVE SPILLWAY CREST (FT.)	AREA ACRES	SURCHARGE STORAGE ACRE-FEET
320.0	0	11	0
321.0	1	11.7	11.4
322.0	2	12.4	23.4
323.0	3	13.1	36.2
324.0	4	13.8	49.6
325.0	5	14.6	63.5
326.0	6	15.4	78.1
327.0	7	16.2	94.5
328.0	8	16.9	111.5
329.0	9	17.7	129.3

BAREOUP POND DAM
STAGE - SURCHARGE STORAGE
CURVE



BY _____ DATE _____

CHKD. BY _____ DATE _____

SUBJECT _____

LOUIS BERGER & ASSOCIATES INC.

SHEET NO 48 OF [illegible]

PROJECT [illegible]

SUMMARY FOR HEC-1 INPUT

HEIGHT ABOVE SPILLWAY CREST (FT)	CUMULATIVE STORAGE (ACRE-FT)	DISCHARGE (CFS)
	0	0
	[illegible]	55
2	[illegible]	103
3	361	390
4	476	453
5	58?	632
6	[illegible]	812
7	14[illegible]	1005

BY D. LANG DATE Sept. 80 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO A9 OF A16

CHKD. BY _____ DATE _____ EAREC IR. POLIS DAM PROJECT C-2502

SUBJECT DRAWDOWN COMPUTATIONS

LOW LEVEL OUTLET = 12" ϕ C.I. PIPE @ ELEV 207.20

ASSUME INFLOW OF 1 cfs

TOTAL HEAD = 12.80'

- LOSSES DUE TO FRICTION = $0.01 \times 76/2 = 0.32'$

GATE = 1.20'

$\overline{V_T} = 1.53'$

FROM 'DESIGN OF SMALL DAMS' PG 473-487

$H_{AVG.} = (12.80 - 1.53)/2 = 5.64'$

$Q = CA\sqrt{2gH}$

$= 0.57 \times 0.79 (64.4 \times 5.64)^{0.5}$

≈ 8.60 cfs SAY 9.0 cfs

$C = 0.57$

$A = 0.79$ FT^2

∴ TIME REQUIRED TO DRAWDOWN FROM ELEV. 220.0 TO ELEV 207.20

$= \frac{43560 \times 106}{8 \times 3600} = 163.4$ HRS. $\cong$ 6.8 DAYS

JOB SPECIFICATION

NC	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
100	0	15	0	0	0	0	0	0	0

JOPER	NWT
3	0

SUB-AREA RUNOFF COMPUTATION

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
1	0	0	0	0	0	1

HYDROGRAPH DATA

IHYDG	HUARE	TRAREA	SNAP	TRSDA	TRSPC	RATIO	ISAME	LOCAL
1	1	0.55	5.0	0.59	0.00	0.000	0	0

PRECIP DATA

NP	STORM	DAJ	DAD
24	0.00	0.00	0.00

PRECIP PATTERN

0.02	0.04	0.04	0.04	0.07	0.07	0.08	0.09	0.14	0.16
0.20	0.30	0.50	0.70	1.70	0.40	0.13	0.11	0.09	0.08
0.06	0.05	0.04	0.03						

LOSS DATA

STRTQ	QRCSN	RTIOL	ERAIN	STRKS	RTIOR	STRTL	CNSTL	ALSMX	RTIMP
0.00	0.00	1.00	0.00	0.00	1.00	0.50	0.10	0.00	0.00

GIVEN UNIT GRAPH, NUHGQ= 9

100	354	412	295	164.	97.	55	32.	20

UNIT GRAPH TOTALS 1523 CFS OR 1.00 INCHES OVER THE AREA

RECESSION DATA

STRTQ= 0.00 QRCSN= 0.00 RTIOR= 1.00

BY ____________ DATE ________ **LOUIS BERGER & ASSOCIATES INC.** SHEET NO ____ OF ____

CHKD. BY ______ DATE ________ PROJECT ____________

SUBJECT ______________________________

END-OF-PERIOD FLOW

TIME	RAIN	EXCS	COMP Q
1	0.06	0.00	0.
2	0.06	0.00	0.
3	0.06	0.00	0.
4	0.06	0.00	0.
5	0.07	0.00	0.
6	0.07	0.00	0.
7	0.08	0.00	[illegible]
8	0.09	[illegible]	[illegible]
9	[illegible]	0.12	[illegible]
10	0.16	[illegible]	70.
11	0.30	0.27	134
12	0.30	0.27	220.
13	0.30	0.27	300
14	0.70	0.67	395
15	1.70	1.67	671
16	[illegible]	0.38	1072
17	0.11	0.08	1118.
18	0.11	0.08	830.
19	0.09	0.07	548.
20	0.09	0.07	364
21	0.07	0.04	248
22	0.06	0.03	175
23	0.06	0.03	122.
24	0.06	0.03	73.
25	0.00	0.00	58.
26	0.00	0.00	42.
27	0.00	0.00	25.
28	0.00	0.00	14.
29	0.00	0.00	7.
30	0.00	0.00	4.
31	0.00	0.00	2.
32	0.00	0.00	1.
33	0.00	0.00	0.
34	0.00	0.00	0
35	0.00	0.00	0.
36	0.00	0.00	0
37	0.00	0.00	0.
38	0.00	0.00	0.
39	0.00	0.00	0
40	0.00	0.00	0
41	0.00	0.00	0
42	0.00	0.00	0.
43	0.00	0.00	0
44	0.00	0.00	0
45	0.00	0.00	[illegible]
46	0.00	0.00	[illegible]
47	0.00	0.00	0
48	0.00	0.00	0
49	0.00	0.00	[illegible]
[illegible]	[illegible]	[illegible]	
51	0.00	0.00	[illegible]
52	0.00	0.00	0
53	0.00	0.00	[illegible]
54	0.00	0.00	0
55	0.00	0.00	[illegible]
56	0.00	0.00	[illegible]
57	0.00	0.00	[illegible]
58	0.00	0.00	0.
59	0.00	0.00	0
60	0.00	0.00	[illegible]
61	0.00	0.00	0
62	0.00	0.00	0
63	0.00	0.00	0.
64	0.00	0.00	0.
65	0.00	0.00	0.
66	0.00	0.00	0
67	0.00	0.00	0
68	0.00	0.00	0
69	0.00	0.00	[illegible]
70	0.00	0.00	0
71	0.00	0.00	0
72	0.00	0.00	0.
73	0.00	0.00	0
74	0.00	0.00	[illegible]
75	0.00	0.00	0
76	0.00	0.00	0
77	0.00	0.00	0.
78	0.00	0.00	0
79	0.00	0.00	0
80	0.00	0.00	0
81	0.00	0.00	0
82	0.00	0.00	[illegible]
83	0.00	0.00	[illegible]
84	0.00	0.00	[illegible]
85	0.00	0.00	0
86	0.00	0.00	[illegible]
87	0.00	0.00	[illegible]
88	0.00	0.00	0
89	0.00	0.00	0
90	0.00	0.00	0
91	0.00	0.00	0
92	0.00	0.00	[illegible]
93	0.00	0.00	
94	0.00	0.00	[illegible]
95	0.00	0.00	[illegible]
[illegible]	[illegible]	0.00	[illegible]
[illegible]	[illegible]	0.00	[illegible]
[illegible]	[illegible]	0.00	[illegible]
[illegible]	[illegible]	0.00	
100	0.00	0.00	
	[illegible]	4.25	[illegible]

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1118.	[illegible]	[illegible]	[illegible]	[illegible]
INCHES		4.29	4.29	4.29	4.29
AC-FT		135	135	[illegible]	135

BY _____ DATE _____

CHKD. BY _____ DATE _____

SUBJECT _____

LOUIS BERGER & ASSOCIATES INC.

SHEET NO. _____ OF _____

PROJECT _____

ROUTING THROUGH RESERVOIR

	ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
	1	1	0	0	0	1	1

ROUTING DATA

		CLOSS	CLOSS	AVG	IRES	ISAME
		0.0	0.000	0.10	1	1

	NSTPS	NSTOL	LAG	AMSKK	X	TSK	STORA
	1	0	0	0.000	0.000	0.111	0

STORAGE	0.	11.	23.	35.	50.	64.	79.	95
OUTFLOW:	0.	55.	163.	300.	458.	632.	812.	1005

TIME	EOP STOR	AVG IN	EOP OUT
1	0	0	0
2	0.	0	0.
3	0.	0.	0
4	0.	0	0.
5	0.	0.	0
6	0.	0.	0
7	0.	0.	0
8	0.	2.	0
9	0.	14.	2.
10	1.	47	9
11	3.	108.	31
12	6.	177.	80
13	11.	260	132
14	16.	347.	100
15	25.	533	176
16	38.	671	313
17	52	1005	484
18	61.	976.	596
19	60.	892	617
20	60	456	591
21	53.	305	511
22	49.	213	450
23	43.	145	389
24	38	98	332
25	33	67	283
26	29	50	246
27	24	33	197
28	23	19	183
29	20	11	131
30	17	5	116
31	15	3	91
32	14	1	77
33	12	0	69
34	11	0	61
35	10	0	56
36	9	0	51
37	8	0	46
38	7	0	36
39	7	0	33
40	6	0	31

BY _____ DATE _____

CHKD. BY _____ DATE _____

SUBJECT _____

LOUIS BERGER & ASSOCIATES INC.

SHEET NO _____ OF _____

PROJECT _____

42	5	0	24
43	5	0	23
44	4	0	22
45	4	0	21
46	3	0	20
47	3	0	19
48	3	0	18
49	3	0	17
50	3	0	16
51	3	0	15
52	3	0	14
53	3	0	13
54	2	0	12
55	2	0	11
56	1	0	10
57	1	0	9
58	1	0	8
59	1	0	7
60	1	0	6
61	1	0	5
62	1	0	4
63	1	0	3
64	1	0	2
65	1	0	1
66	0	0	0
67	0	0	0
68	0	0	0
69	0	0	0
70	0	0	1
71	0	0	1
72	0	0	1
73	0	0	1
74	0	0	1
75	0	0	1
76	0	0	1
77	0	0	1
78	0	0	1
79	0	0	1
80	0	0	1
81	0	0	0
82	0	0	0
83	0	0	0
84	0	0	0
85	0	0	0
86	0	0	0
87	0	0	0
88	0	0	0
89	0	0	0
90	0	0	0
91	0	0	0
92	0	0	0
93	0	0	0
94	0	0	0
95	0	0	0
96	0	0	0

LOUIS BERGER & ASSOCIATES INC.

97	0.	0	0.
98	0.	0	0
99	0.	0	0
100	0	0	0
SUM			6527.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	617.	302.	98.	65.	652?
INCHES		3.?8	4.??	4.?9	4.??
AC-FT		120.	135.	135.	135.

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RUNOFF SUMMARY, AVERAGE FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	ARE?
HYDROGRAPH AT	1	1118.	272.	65.	65.	0 ??
ROUTED TO	1	617.	252.	68.	65.	0 ??


EN